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Articles:

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Detection of pulpal circulation in vitro by pulse oximetry

Noblett WC, Wilcox LR, Scamman F, Johnson WT, Diaz-Arnold A. Detection of pulpal circulation in vitro by pulse oximetry. J Endodon 1996;22:1-5.

PURPOSE: To evaluate pulse oximetry as a potential method of determining pulp vitality; specifically, to develop a pulse oximetry sensor for a tooth, to develop an in vitro model of the pulpal circulation, and to test the ability of the sensor to detect changes in oxygen saturation of blood circulated through the model.

M&M: The roots were removed from an intact mandibular molar, all pulp tissue was removed, and polypropylene tubing was secured inside the chamber, to simulate a vascular system. A neonatal pulse oximeter sensor was modified, and attached to a rubber dam clamp, which was affixed to the tooth. Fresh human blood samples were mixed with each of three gas mixtures: 8, 13, or 15% oxygen, along with 5% CO_2, and the balance consisting of nitrogen. These samples were pumped through the tooth in a pulsatile fashion, and stable oxygen saturation readings were obtained. Blood exiting the tooth was analyzed by blood gas analysis for comparison.

RESULTS: A highly significant correlation between the pulse oximeter and blood gas analysis values was demonstrated. The largest discrepancy between the two, over an oxygen saturation range of 67-95%, was only 2%.

C&C: The success of this in vitro experiment is encouraging. Pulse oximetry may someday soon be adaptable to the detection of pulpal blood circulation, a true measure of pulpal vitality. Potential applications would include cases of impact injury to the teeth during which the nerve supply may be injured, but the blood supply remains intact. Being an objective test, factors such as patient adaptation and response perception could be taken out of the vitality equation entirely. Although promising, much technical refinery awaits completion.

January 1996 **Christopher F. Bates**

Sealing ability of the vertical condensation with different root canal sealers

Yared GM, Dagher FB. Sealing ability of the vertical condensation with different root canal sealers. J Endodon 1996;22:6-8.

PURPOSE: To compare the influence of different root canal sealers on the quality of the apical seal of vertically condensed gutta-percha.

M&M: 120 single-rooted human teeth with one canal were used. The crowns were removed at the CEJ and the teeth were cleaned and shaped to an apical size #30. The teeth were randomly divided into 3 experimental groups and 1 control group of 30 teeth each. All teeth were obturated with vertically condensed GP, group 1 without sealer, group 2 using Kerr Pulp Canal Sealer, group 3 using AH26, and group 4 using Roth's 801. Apical microleakage was determined using a pressurized fluid filtration method measured at 1.5 h, 1 d, and 1, 4, 12, 18, and 24 wk for groups 2-4, and at 1.5 h, 1 d, and 1, 4, and 24 wk for the control group.

RESULTS: Microleakage tended to increase in all experimental groups from 1 to 24 wks. Roth's and AH26 showed significantly more leakage at 24 wk than at 18 wk, which was significantly more than that shown by Kerr's. Microleakage in the controls was significantly higher than in the experimental teeth at all time intervals.

C&C: Another leakage study that shows that unsealed GP fills leak more than sealed ones do; root canal sealer is necessary to prevent apical leakage. Kerr's Pulp Canal Sealer performed better than Roth's or AH26 in this study.

January 1996 **Michael Hall**

Interleukin-8 gene expression by human dental pulp fibroblast in cultures stimulated with Prevotella intermedia lipopolysaccharide

Nagaoka S, Tokuda M, Sakuta T, Taketoshi Y, Tamura M, Takada H, Kawagoe M. Interleukin-8 gene expression by human dental pulp fibroblast in cultures stimulated with Prevotella intermedia lipopolysaccharide. J Endodon 1996;22:9-12.

PURPOSE: To determine the effects of *P. intermedia* LPS, bacterial and synthetic endotoxins, and some inflammatory cytokines on IL-8 mRNA expression and IL-8 release in cultured human dental pulp fibroblasts.

M&M: Homologous fibroblasts from a 17-yr-old's third molar pulps were minced, and exposed to several stimulants in culture: LPS from *P. intermedia*, LPS from *Salmonella abortus-equi*, synthetic lipid-A, natural human interferon, recombinant human IL-1a, and recombinant human tumor necrosis factor-a. The expression of IL-8 mRNA was detected by Northern blot analysis. IL-8 release was assayed for stimulated and unstimulated pulp fibroblasts, using a specific capture ELISA.

RESULTS: IL-8 mRNA concentrations began to increase after 2 h exposure to *P. intermedia* LPS, reached a maximum at 4-8 h, and declined to the unstimulated levels by 60 h. Expression of IL-8 m-RNA was efficiently stimulated by 0.1-100 µg/ml of *P. intermedia* LPS (dose-dependent), whereas *S. abortus-equi* LPS induced expression only slightly. The synthetic lipid-A also did not increase IL-8 mRNA concentrations over those of unstimulated controls. Recombinant human IL-1a and tumor necrosis factor-a were capable of stimulating these cells to express IL-8 mRNA, but natural human interferon and recombinant human IL-6 were incapable.

C&C: These results suggested that pulpal fibroblasts are immunoresponsive cells, and can elaborate IL-8 upon stimulation with *Prevotella intermedia* LPS. In comparison to gingival fibroblasts, pulpal fibroblasts produce IL-8 following a much smaller quantity of stimulant, and much earlier. This additional sensitivity is supposedly necessary, due to the dental pulp's high susceptibility to internal stimuli. The IL-8 is believed to be a key cytokine in neutrophil chemotaxis and the initiation of pulpal lesions. [Very light reading, a bit oversimplified]

January 1996 **Christopher F. Bates**

An in vitro evaluation of the sealing ability of Super-EBA cement used as a root canal sealer

Fulkerson MS, Czerw RJ, Donnelly JC. An in vitro evaluation of the sealing ability of Super-EBA cement used as a root canal sealer. J Endodon 1996;22:13-8.

PURPOSE: To compare apical microleakage in teeth after root canal filling with either a single GP cone and Super-EBA or with laterally condensed GP and Roth's 801 sealer.

M&M: 46 extracted teeth were used, 26 max centrals and 20 man incisors. The teeth were prepared to a size #50 (max incisors) and size #30 (man incisors). The teeth were divided into experimental and control groups: group 1 consisted of 10 max centrals filled with LC GP using Roth's 801 sealer; group 2, 10 man incisors filled the same way; group 3, 10 max incisors filled with a single master cone and Super-EBA; group 4, 10 man incisors filled as in group 3. There were also 3 positive and 3 negative control teeth. The teeth were suspended in India ink for 48 h. After the teeth were chemically cleared, apical microleakage was assessed.

RESULTS: There was no significant difference in mean apical leakage for max incisors filled with Super-EBA and a single GP cone or LC of GP with Roth's sealer. There was significantly less apical leakage for man incisors using the single cone GP/Super-EBA technique.

C&C: Due to the short clinical working time of Super-EBA, the single cone GP method was used, since LC may not be feasible. Pilot studies reportedly indicated that retreatment or post-space preparation following this technique was not a problem, although I am sure that Super-EBA removal is more time-consuming than just GP and conventional ZOE sealers. The leakage results indicate this as a promising technique, though studies with longer time intervals might be useful.

January 1996 **Michael Hall**

Optical detection of hemoglobin in pulpal blood

Diaz-Arnold AM, Arnold MA, Wilcox LR. Optical detection of hemoglobin in pulpal blood. J Endodon 1995 22:19-22.

PURPOSE: To determine if optical methods can detect hemoglobin (Hb) within the pulp space.

M&M: Light emitting diodes and a photodiode detector were positioned directly on opposite surfaces of the experimental teeth (incisors and premolars). Clear tubing was sealed to the coronal access cavity and connected to a syringe infusion pump. Fresh bovine blood was prepared to various Hb concentrations (4-20 g/dl), which were verified using a conventional cyanmethemoglobin method. Blood solutions were pumped through each tooth for 1 min, and transmitted light intensities were recorded. Additionally, anaerobically stored, whole bovine blood and blood-saline solutions of 1:1, 1:2, 1:4, 1:8, and 1:16 were pumped through an incisor in order of ascending concentration; transmitted light intensities were again collected.

RESULTS: The relationship between the intensity of light and hemoglobin concentration was found to fit a nonlinear mathematical formula almost exactly. Optical measurements correlated very well with Hb values measured by conventional methods. The mean percentage error was 5.8%, and the standard error of prediction was 0.77 g/dl. Absorbance values (indicative of oxygenation levels) were 31% higher for deoxygenated blood.

C&C: These findings show additional promise for future use of light transmission through teeth as a pulpal diagnostic aid; in these cases, a means of assessing total hemoglobin and blood oxygenation within the pulp chamber. Optical techniques should offer the advantages of simplicity and noninvasiveness.

January 1996 **Christopher F. Bates**

Histochemical analysis of dental hard tissues following bleaching

Rotstein I, Kankner E, Goldman A, Heling I, Stabholz A, Zalkind M. Histochemical analysis of dental hard tissues following bleaching. J Endodon 1996;22:23-6.

PURPOSE: To assess the effect of commonly used bleaching agents on intact nonpulverized teeth.

M&M: 21 extracted premolars were used. The apical 2/3 of the roots were removed and the remaining pulp stumps longitudinally split into 2 halves. These were divided into 6 experimental groups, each treated with one of the following bleaching agents: 30% hydrogen peroxide (HP), 10% carbamide peroxide (CP), sodium perborate (SP), Nu-Smile (NS), Opalescence (OP), and DentlBright (DB), the last 3 of which are home-bleaching gels. The samples were immersed in the test solutions, incubated for 7 d at 37ºC, and then prepared for energy-dispersive spectrometric analysis using SEM. The levels of Ca, P, S, and K were measured in the enamel, dentin, and cementum.

RESULTS: A significant reduction in the Ca/P ratio was seen in the enamel following treatment with HP, in the dentin following treatment with HP, CP, DB, and OP, and in the cementum following treatment with HP, CP, NS, and OP. Significant reduction in S occurred only in the cementum following treatment with CP and SP, and S levels increased significantly following treatment with NS. Significant reduction in K levels occurred only in the dentin following treatment with CP.

C&C: The results indicate that the most popular intra- and extracoronal bleaching agents used today are not benign, and do result in adverse effects to dental hard tissues. Therefore, caution should be exercised when bleaching is performed.

January 1996 **Michael Hall**

Root canal irrigation with citric acid solution

Yamaguchi M, Toshida K, Suzuki R, Nakamura H. Root canal irrigation with citric acid solution. J Endodon 1996;22:27-9.

PURPOSE: To evaluate the decalcifying and antimicrobial properties of citric acid and EDTA.

M&M: A mixture of powdered dentin and resin were polymerized into disc form, and the discs were placed into 1 ml of each of the following: 0.1 M, 0.5 M, 1 M, and 2 M citric acid solution; 0.1 M and 0.5 M citric acid: sodium citrate acid; 0.5 M EDTA; and distilled water as a control. Following various exposure times, solutions were analyzed for amount of calcium present, using atomic absorption spectrophotometry. Additionally, 12 microorganisms isolated from infected root canals were exposed to 0.1 ml of each test solution. Following either 2 d (aerobic) or 5 d (anaerobic) culturing, the produced zones of inhibition were measured.

RESULTS: Calcium extracted by 0.1 M citric acid was sig less than other solutions. The amounts of calcium extracted by 0.5, 1, and 2 M citric acid solutions were sig more than those extracted by the 0.5 M EDTA. Citric acid solution showed antibacterial effects on all the bacteria used; at concentrations of 1 and 2 M, citric acid showed strong activity against many organisms. The antimicrobial activity of EDTA was similar to that of 1 and 2 M citric acid solutions.

C&C: Favorable findings demonstrated here suggest that citric acid may be useful as an irrigating solution for the root canal. The decalcifying ability of the 0.5, 1, and 2 M citric acid solutions was slightly more than that of the 0.5 M EDTA. 0.5, 1, and 2 M citric acid, and 0.5 M EDTA had antimicrobial activity against all 12 strains of bacteria. Antimicrobial activities of 0.5 M citric acid, and both concentrations of citric acid:sodium were weak.

January 1996 **Christopher F. Bates**

Effects of long-term exposure of human periodontal ligament cells to milk and other solutions

Huang S-C, Remeikis NA, Daniel JC. Effects of long-term exposure of human periodontal ligament cells to milk and other solutions. J Endodon 1996;22:30-3.

PURPOSE: To compare viability of cultured human PDL cells in whole milk and contact lens solution.

M&M: Human PDL cells from extracted teeth were cultured and then exposed to 1 of 4 different culture media: whole milk, Alcon Opti-Free contact lens solution (CLS), K-Mart CLS, and sterile saline. The cells were incubated at either 4ºC or 20ºC (room temp). Morphological changes in the cells were recorded after exposure for 0, 1, 3, 6, 10, 16, 24, 36, 48, 72, and 96 h.

RESULTS: The CLS gave the poorest results at both 4ºC and 20ºC. Saline was better, but not by much. Much better results were obtained with milk at both temps. HBSS gave the best results (it was used as a control).

C&C: As a short-term storage medium for avulsed teeth, milk is superior to saline and CLS, but inferior to HBSS.

January 1996 **Michael Hall**

Endodontic applications of guided tissue regeneration in endodontic surgery

Rankow HJ, Krasner PR. Endodontic applications of guided tissue regeneration in endodontic surgery. J Endodon 1996;22:34-43.

REVIEW: Many of the causes of endodontic failure can be attributed to the presence of endodontic-periodontic bone loss around roots. Guided tissue regeneration (GTR) procedures have been shown to successfully manage several types of periodontal bone loss. The GTR principle involves a differential tissue response. The surgical procedure includes the placement of a barrier between the gingiva and the root surface, which prevents the faster proliferating epithelium and gingival connective tissues from reaching the root before the slower periodontal ligament and bone. There are many conditions in which supporting periodontium and alveolar bone are lost because of an endodontic cause; in these, GTR can be used to create an environment more conducive to healing. The categories of GTR applications in endodontic surgery are: (1) apical pathosis without communication to the alveolar crest; (2) apical pathosis with communication to the alveolar crest, eg dehiscence, proximal bone loss, and developmental grooves; (3) root or furcation bone loss caused by perforations (both with and without communication to the alveolar crest); (4) cervical root resorption; (5) oblique root fracture; and (6) ridge augmentation (in conjunction with root resection or extraction). Six cases were presented, most of which were treated using ePTFE periodontal membranes (transgingival or augmentation), and demineralized freeze-dried bone allografts (DFDBA).

DISCUSSION: A long junctional epithelial attachment can create avenues for microbial contamination of the apex, and contributes to a poorer prognosis. The formation of a bone barrier induced by a GTR procedure should assist in sealing the apex from the oral environment. It is not convenient for the patient to undergo endodontic surgery, and receive the surgical GTR procedures at a subsequent visit; the endodontist should perform both procedures simultaneously. Some important principles: an adequate amount of periodontal ligament must remain to provide the source of undifferentiated cells for new attachment; sufficient space must be created and maintained under the barrier to allow for ingrowth (DFDBA is believed by many to be the best space maintainer); any barrier composition is acceptable, as long as it is biocompatibile and prevents tissue entrance into the wound for 4-6 wks; a submerged barrier cannot be used unless the flap covers it coronally by at least 2 mm. Generally, if the membrane used can isolate the space for at least 60 d, success can be expected.

January 1996 **Christopher F. Bates**

An unusual attempt at surgical repair

Brown, Jr CE, Legan JJ. An unusual attempt at surgical repair. J Endodon 1996;22:44-5.

PURPOSE: To report a case in which gold foil was used to attempt repair of an improperly healed surgical site.

CASE REPORT: A 26-yr-old female was seen following placement of gold foil beneath a surgical flap in the lower incisor region. The original surgery was performed by a general dentist who then punted to an oral surgeon when the area failed to heal properly. The OS placed the gold foil, which was exposed by the time the authors saw the patient. They removed the foil, but subsequent treatment met only limited success in correcting the soft tissue defect. #25 had to be extracted.

January 1996 **Michael Hall**